Noise Measurements and Noise Distribution in the City of Szeged

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Abstract
Measurements were carried out on different picked points of Szeged to achieve a noise distribution of the city. Careful measurements were carried out to obtain the environmental noise load values caused by traffic. The noise distribution data were taken in 2012 and the measurements were repeated on the same locations in 2015, too.

Introduction
Our most important senses are sight and hearing. Almost all the information is acquired through them. 83% percent of the information is taken through sight and 11% through the hearing. The modern era brought a lot of mechanization and automation. More and more people live in big, crowded cities. The current environment – comparing to the original, natural environment – is noisy. This noise can be even harmful to the hearing. It is necessary to check from time to time that our environment is still within the healthy limits.
The normal hearing ranges from 20 Hz frequency to 20000 Hz.[1]
The hearing is logarithmic. The industrial tools for noise measurements are based on sound pressure level and the data are given in decibel (dB).[2] The sound pressure level is given by Eq.1:

$$L_p = 20log_{10}\left(\frac{\Delta p}{p_0}\right)\ dB \qquad (1)$$

where Δp is the sound pressure fluctuation, and p_0 is the reference pressure fluctuation value (audition threshold); p_0 = 20 μPa.

Table 1 contains some common examples

L(SPL) (dB)	*phenomenon*
0	audition threshold; mosquito at 3 m
10	human breathing at 3 m
30	theatrical stillness
40	living area at night; stillness of nature
60	office
70	street traffic at 5 m
90	noise in factory
100	jackhammer at 1 m; disco inside
120	train horn at 10 m
130	pain threshold

Table 1. Sound pressure level examples

It is worth noting that 85 dB or higher sound pressure level over long-term exposure can cause hearing damage. The hearing damage is cumulative throughout the entire life.

The auditory sensation strongly depends on the frequency of the sound: at the same sound pressure level a 200 Hz sound feel much weaker than a 1000 Hz sound. The equal loudness curves are measured first by Harvey Fletcher and Wilden A. Munson in 1933. The measurements were repeated in the 2000-2003 period.[3][4][5]

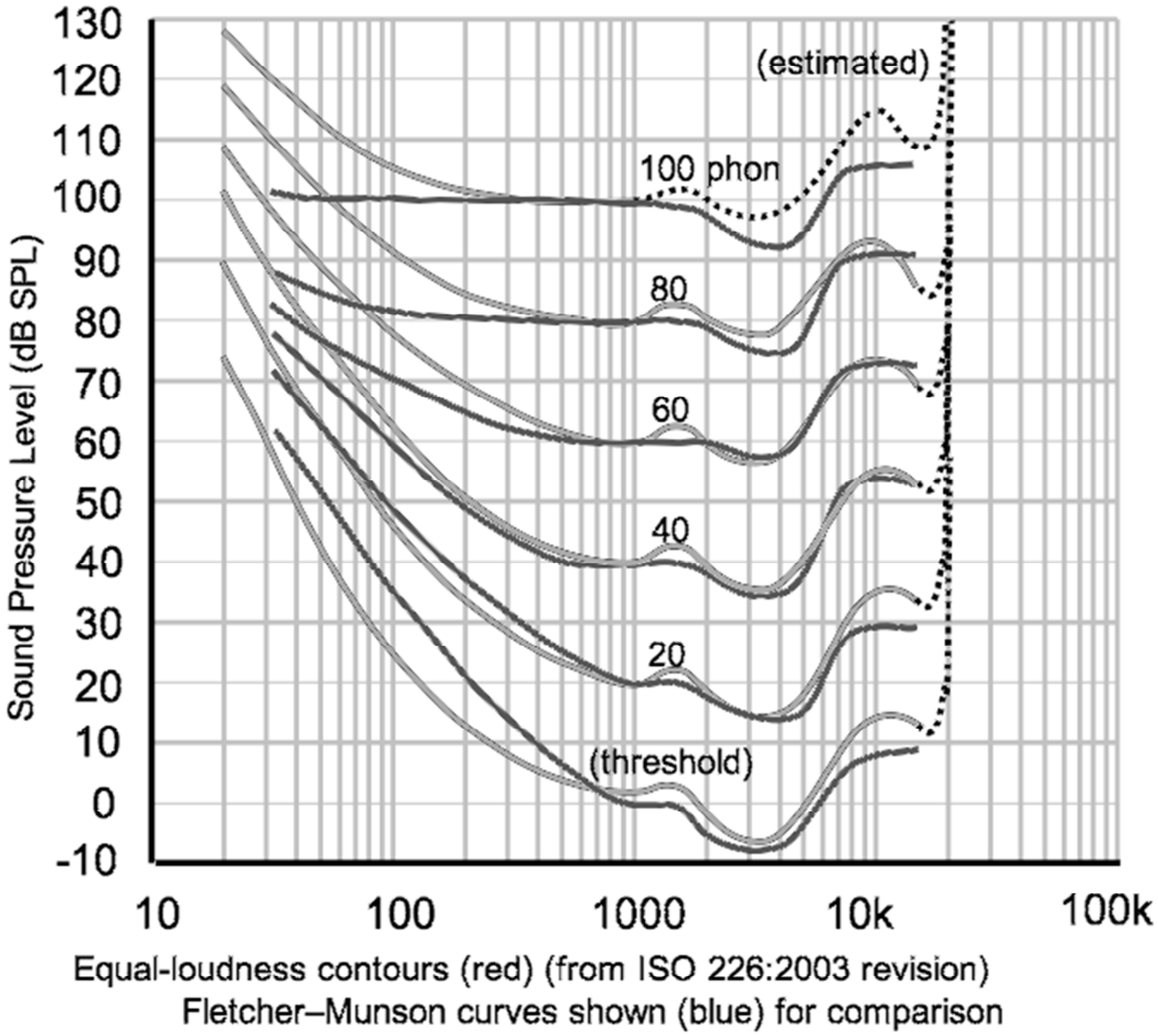

Figure 1. Fletcher-Munson curves (dark) and ISO226:2003 (light) [6]

The industrial noise meters use weighting curves to show similar responses to the human hearing. The A-weighting is used for auditory purposes. The C-weighting is almost flat; that can be used as the real physical sound pressure.[7]
Though +6 dB means twice the power, the human perception does not work this way. What is heard two times louder is +10 dB more.[8][9]

Experimental

The noise level was measured in a school in the corridor in a break. It was in the range of 75-85 dB with using A-weighting and C-weighting as well. That means that the noise caused by children is at the most sensitive frequency of hearing. This value can lead to the teachers' loss of hearing.

The noises of different vehicles were measured from the pavement of a road by using A and C weighting as well. The much larger C values show that the vehicles have a big amount of low frequency emission, too.

vehicle	*A-weighting (dB)*	*C-weighting (dB)*
car	65-70	80-85
trolley/truck	70-75	85-90
tram	73-77	88-92
motorcycle	75-85	90-100

Table 2. Typical noise levels of vehicles

Different locations were chosen to achieve a noise distribution of the city of Szeged.

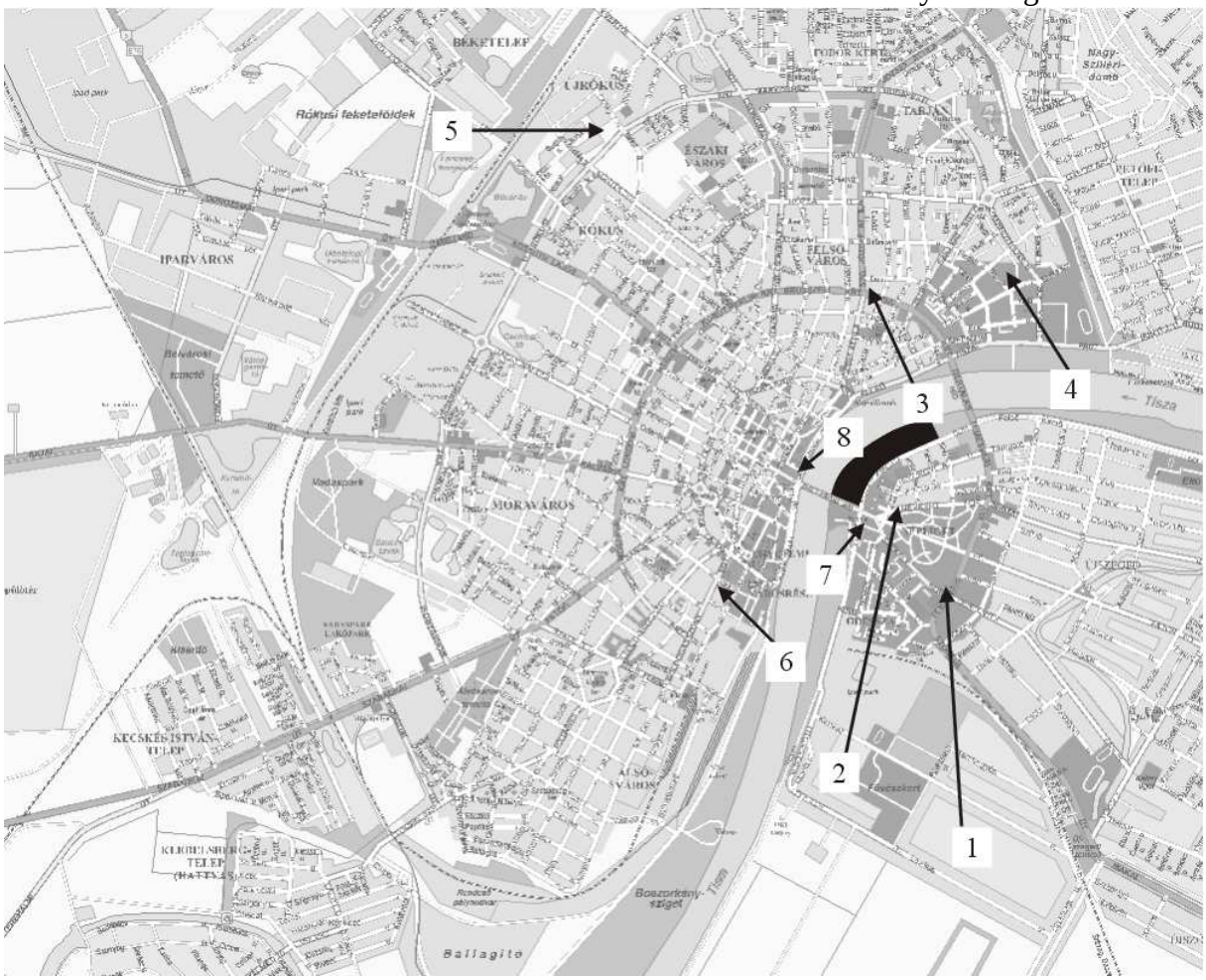

Figure 2. Locations of measuring in Szeged

number	*location (GPS)*
1	intersection of Székely sor and Temesvári krt. (46^{o} 14.728’ N ; 020^{o} 09.842’ E)
2	close to the bridge (46^{o} 14.991’ N ; 020^{o} 09.605’ E)
3	intersection of Római krt. and József Attila sgt. (46^{o} 15.696’ N ; 020^{o} 09.479’ E)
4	council block, Csaba u. 43 (46^{o} 15.732’ N ; 020^{o} 10.116’ E)
5	school at Rókusi krt. near Tesco (46^{o} 16.253’ N ; 020^{o} 08.290’ E)
6	school at Boldogasszony sgt. 8 (46^{o} 14.759’ N ; 020^{o} 09.738’ E)

7	parking area at the bridge (46° 14.933' N ; 020° 09.410' E)
8	museum garden (46° 15.124' N ; 020° 09.162' E)

Results and discussion

The measured values are shown in the next table. The A-weighting curve was used.

location	*workday morning (7h-8h) dB*	*workday daytime (12h-15h) dB*	*workday evening (20h-22h) dB*	*Sunday daytime (9h-12h) dB*
1 (2012)	61.9 ± 5.2	55.5 ± 7.1	52.9 ± 6.8	54.9 ± 7.7
1 (2015)	*64.6 ±6.0*	*58.0 ±8.0*	*52.2 ±7.7*	*56.9 ±8.0*
2 (2012)	59.2 ± 7.3	57.4 ± 7.8	54.9 ± 8.1	54.4 ± 8.3
2 (2015)	*60.7 ±8.5*	*56.9 ±9.9*	*55.6 ±7.1*	*59.8 ±9.2*
3 (2012)	64.4 ± 3.4	63.4 ± 4.3	60.0 ± 4.9	61.1 ± 4.1
3 (2015)	*67.5 ±2.7*	*65.1 ±4.0*	*60.1 ±5.0*	*66.4 ±6.3*
4 (2012)	43.4 ± 2.1	50.0 ± 3.5	42.9 ± 2.9	41.6 ± 4.4
4 (2015)	*44.6 ±2.1*	*35.3 ±2.7*	*42.1 ±4.1*	*45.4 ±3.0*
5 (2012)	57.5 ± 2.9	49.3 ± 2.5	51.4 ± 3.2	50.3 ± 3.5
5 (2015)	*52.1 ±3.3*	*51.0 ±3.3*	*49.0 ±3.2*	*49.3 ±3.6*
6 (2012)	64.0 ± 3.4	59.6 ± 6.2	51.9 ± 8.3	57.9 ± 8.3
6 (2015)	*62.9 ±4.7*	*63.8 ±4.6*	*60.2 ±4.0*	*55.8 ±9.1*

Table 3. Noise levels at the picked locations

A measurement was carried out to check the noise levels of the Youth Days of Szeged (black area in the map) in 2012 and 2015, too. The samples were taken in the timeframe of 22h-24h.

location	*YDS in 2012 (dB)*	*YDS in 2015 (dB)*
1	54.2 ± 6.1	53.8 ± 7.2
2	59.0 ± 4.1	60.6 ± 4.4
7	59.7 ± 2.4	64.2 ± 2.3
8	64.9 ± 2.5	61.3 ± 2.3

Table 4. Noise levels around the area of the Youth Days of Szeged

The results show that Szeged has a quiet acoustical environment.
The Youth Days of Szeged kept the sound levels well within the legal limits.
The measurements do not show significant changes from 2012 to 2015. The acoustical load of traffic is quite acceptable in the city of Szeged and the city has a very good structure to present really quiet living areas.

References

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